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This is a Continuation of U.S. Patent Application Serial No.
09/026,043, filed February 19, 1998, and titled "Method of Addressing
Messages and Communications System"^{now US 6,118,789}

In the Claims

Please cancel claims 1-41 and replace with the following.

~~42~~. A method of establishing wireless communications between
an interrogator and individual ones of multiple wireless identification
devices, the wireless identification devices having respective identification
numbers and being addressable by specifying identification numbers with
any one of multiple possible degrees of precision, the method comprising
utilizing a tree search in an arbitration scheme to determine a degree
of precision necessary to establish one-on-one communications between
the interrogator and individual ones of the multiple wireless identification
devices, a search tree being defined for the tree search method, the tree
having multiple ^{selectable} levels respectively representing subgroups of the multiple
wireless identification devices, the method further comprising starting the
tree search at ^{any} ^{selectable} level of the search tree.

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A method in accordance with claim ~~42~~ and further comprising determining the maximum possible number of wireless identification devices that could communicate with the interrogator, and selecting a level of the search tree based on the determined maximum possible number of wireless identification devices that could communicate with the interrogator.

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A method in accordance with claim ~~43~~ and further comprising starting the tree search at a level determined by taking the base two logarithm of the determined maximum possible number, wherein the level of the tree containing all subgroups is considered level zero, and lower levels are numbered consecutively.

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A method in accordance with claim ~~43~~ and further comprising starting the tree search at a level determined by taking the base two logarithm of the determined maximum possible number, wherein the level of the tree containing all subgroups is considered level zero, and lower levels are numbered consecutively, and wherein the maximum number of devices in a subgroup in one level is half of the maximum number of devices in the next higher level.

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~~46.~~ A method in accordance with claim ²
~~43~~ and further
comprising starting the tree search at a level determined by taking the
base two logarithm of the power of two nearest the determined
maximum possible number, wherein the level of the tree containing all
subgroups is considered level zero, and lower levels are numbered
consecutively, and wherein the maximum number of devices in a
subgroup in one level is half of the maximum number of devices in the
next higher level.

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~~47.~~ A method in accordance with claim ~~42~~ wherein the wireless
identification device comprises an integrated circuit including a receiver,
a modulator, and a microprocessor in communication with the receiver
and modulator.

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receiving the command at multiple devices, devices receiving the command respectively determining if the random value chosen by the device falls within the specified group and, if so, sending a reply to the interrogator; and

1 receiving the command at multiple devices, devices receiving the
2 command respectively determining if the random value chosen by the
3 device falls within the specified group and, if so, sending a reply to the
4 interrogator; and, if not, not sending a reply; and

5 determining using the interrogator if a collision occurred between
6 devices that sent a reply and, if so, creating a new, smaller, specified
7 group by descending in the tree.

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9 ¹³
~~54.~~ A method of addressing messages from an interrogator to a
10 selected one or more of a number of communications devices in
11 accordance with claim ¹²~~53~~ and further including establishing a
12 predetermined number of bits to be used for the random values.

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14 ¹⁴
~~55.~~ A method of addressing messages from an interrogator to a
15 selected one or more of a number of communications devices in
16 accordance with claim ¹³~~54~~ wherein the predetermined number of bits to
17 be used for the random values comprises an integer multiple of eight.

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19 ¹⁵
~~56.~~ A method of addressing messages from an interrogator to a
20 selected one or more of a number of communications devices in
21 accordance with claim ¹³~~54~~ wherein devices sending a reply to the
22 interrogator do so within a randomly selected time slot of a number of
23 slots.

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57.

1 A method of addressing messages from an interrogator to a
2 selected one or more of a number of RFID devices, the method
3 comprising:

4 establishing for respective devices a predetermined number of bits
5 to be used for random values, the predetermined number being a
6 multiple of sixteen;

7 causing the devices to select random values, wherein respective
8 devices choose random values independently of random values selected
9 by the other devices;

10 transmitting a command from the interrogator requesting devices
11 having random values within a specified group of a plurality of possible
12 groups of random values to respond, the specified group being equal to
13 or less than the entire set of random values, the plurality of possible
14 groups being organized in a binary tree defined by a plurality of nodes
15 at respective levels, wherein the maximum size of groups of random
16 values decrease in size by half with each node descended, wherein the
17 specified group is below a node on a level of the tree selected based
18 on the maximum number of devices known to be capable of
19 communicating with the interrogator;

20 receiving the command at multiple devices, devices receiving the
21 command respectively determining if the random value chosen by the
22 device falls within the specified group and, only if so, sending a reply
23 to the interrogator, wherein sending a reply to the interrogator comprises

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1 transmitting both the random value of the device sending the reply and
2 the unique identification number of the device sending the reply;

3 using the interrogator to determine if a collision occurred between
4 devices that sent a reply and, if so, creating a new, smaller, specified
5 group using a level of the tree different from the level used in the
6 interrogator transmitting, the interrogator transmitting a command
7 requesting devices having random values within the new specified group
8 of random values to respond; and

9 if a reply without collision is received from a device, the
10 interrogator subsequently sending a command individually addressed to
11 that device.

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13 ¹⁷
14 ~~58~~. A method of addressing messages from an interrogator to a
15 selected one or more of a number of RFID devices in accordance with
16 claim ¹⁶~~57~~ and further comprising determining the maximum possible
17 number of wireless identification devices that could communicate with the
18 interrogator.
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58.

A method of addressing messages from an interrogator to a selected one or more of a number of RFID devices in accordance with claim ¹⁶~~57~~ wherein selecting the level of the tree comprises taking the base two logarithm of the determined maximum possible number, wherein a level of the tree containing all subgroups is considered level zero, and lower levels are numbered consecutively.

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A method of addressing messages from an interrogator to a selected one or more of a number of RFID devices in accordance with claim ¹⁶~~57~~ wherein selecting the level of the tree comprises taking the base two logarithm of the determined maximum possible number, wherein a level of the tree containing all subgroups is considered level zero, and lower levels are numbered consecutively, and wherein the maximum number of devices in a subgroup in one level is half of the maximum number of devices in the next higher level.

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65. A communications system comprising an interrogator, and a plurality of wireless identification devices configured to communicate with the interrogator in a wireless fashion, the wireless identification devices having respective identification numbers, the interrogator being configured to employ a tree search ^{to} determine the identification numbers of the different wireless identification devices with sufficient precision so as to be able to establish one-on-one communications between the interrogator and individual ones of the multiple wireless identification devices, wherein the interrogator is configured to start the tree search at ^{any} ₁ selectable level of the search tree.

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~~66.~~

A communications system in accordance with claim ²⁴~~65~~ wherein the tree search is a binary tree search.

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~~67.~~

A communications system in accordance with claim ²⁴~~65~~ wherein the wireless identification device comprises an integrated circuit including a receiver, a modulator, and a microprocessor in communication with the receiver and modulator.

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~~68.~~

A system comprising:

an interrogator;

a number of communications devices capable of wireless communications with the interrogator;

means for establishing a predetermined number of bits to be used as random numbers, and for causing respective devices to select random numbers respectively having the predetermined number of bits;

means for inputting a predetermined number indicative of the maximum number of devices possibly capable of communicating with the receiver;

means for causing the interrogator to transmit a command requesting devices having random values within a specified group of random values to respond, the specified group being chosen in response to the predetermined number;

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means for causing the interrogator to determine if a collision occurred between devices that sent a reply and, if so, create a new, smaller, specified group.

~~70.~~ A system in accordance with claim ~~68~~ wherein the interrogator further includes means for, after receiving a reply without collision from a device, sending a command individually addressed to that device.

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A system comprising:

an interrogator configured to communicate to a selected one or more of a number of communications devices;

a plurality of communications devices;

the devices being configured to select random values, wherein respective devices choose random values independently of random values selected by the other devices, different sized groups of devices being addressable by specifying random values with differing levels of precision;

the interrogator being configured to transmit a command requesting devices having random values within a specified group of a plurality of possible groups of random values to respond, the specified group being less than the entire set of random values, the plurality of possible groups being organized in a binary tree defined by a plurality of nodes at respective levels, wherein the size of groups of random values decrease in size by half with each node descended, wherein the specified group is below a node on the tree selected based on a predetermined maximum number of devices capable of communicating with the interrogator;

devices receiving the command being configured to respectively determine if their chosen random values fall within the specified group and, if so, send a reply to the interrogator; and, if not, not send a reply; and

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75. A system comprising:

an interrogator configured to communicate to a selected one or more of a number of RFID devices;

a plurality of RFID devices, respective devices being configured to store unique identification numbers respectively having a first predetermined number of bits, respective devices being further configured to store a second predetermined number of bits to be used for random values, respective devices being configured to select random values independently of random values selected by the other devices;

the interrogator being configured to transmit an identify command requesting a response from devices having random values within a specified group of a plurality of possible groups or random values, the specified group being less than or equal to the entire set of random values, the plurality of possible groups being organized in a binary tree defined by a plurality of nodes at respective levels, wherein the maximum size of groups of random values decrease in size by half with each node descended, wherein the specified group is below a node on a level of the tree selected based on a predetermined number based on the maximum number of devices known to be capable of communicating with the interrogator;

devices receiving the command respectively being configured to determine if their chosen random values fall within the specified group and, only if so, send a reply to the interrogator, wherein sending a reply

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1 to the interrogator comprises transmitting both the random value of the
2 device sending the reply and the unique identification number of the
3 device sending the reply;

4 the interrogator being configured to determine if a collision
5 occurred between devices that sent a reply and, if so, create a new,
6 smaller, specified group using a level of the tree different from the level
7 used in previously transmitting an identify command, the interrogator
8 transmitting an identify command requesting devices having random values
9 within the new specified group of random values to respond; and

10 the interrogator being configured to send a command individually
11 addressed to a device after communicating with a device without a
12 collision.

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14 ³⁵~~76~~. A system in accordance with claim ³⁴~~75~~ wherein the
15 interrogator is configured to input and store the predetermined number.

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17 ³⁶~~77~~. A system in accordance with claim ³⁴~~75~~ wherein the devices
18 are configured to respectively determine if their chosen random values
19 fall within a specified group and, if so, send a reply, upon receiving
20 respective identify commands.

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78. A system in accordance with claim 77 wherein the interrogator is configured to determine if a collision occurred between responses that sent a reply in response to respective identify commands and if so, create further new specified groups and repeat the transmitting of the identify command requesting devices having random values within a specified group of random values to respond using different specified groups until all responding devices are identified.--

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